

WHAT IS CLAIMED IS:

1. A bubble-actuated valve comprising:
 - a substrate layer;
 - 5 a cap layer;
 - at least one inlet formed in at least one of the substrate layer and the cap layer;
 - 10 at least one outlet formed in at least one of the substrate layer and the cap layer;
 - at least one flow channel, formed in at least one of the substrate layer and the cap layer, connecting the at least one inlet to the at least one outlet;
 - 15 at least one device for forming a bubble; and
 - a moveable solid object, the moveable solid object being moveable between a first position, wherein fluid flows from the at least one inlet to the at least one outlet, and a second position, wherein fluid flow from the at least one inlet to the at least one outlet is blocked, the moveable solid object being moved by at least one of the bubble and the force generated by the formation 20 of the bubble.
2. The bubble-actuated valve according to claim 1, wherein the at least one device for forming a bubble is a heating element affixed to at least one of the substrate layer or the cap layer.
- 25 3. The bubble-actuated valve according to claim 1, wherein the moveable solid object comprises a spherical element.
4. The bubble-actuated valve according to claim 1, wherein the 30 substrate layer comprises silicon.
5. The bubble-actuated valve according to claim 1, wherein the substrate layer comprises a polymeric material.

6. The bubble-actuated valve according to claim 1, wherein the substrate layer comprises a ceramic material.

5 7. The bubble-actuated valve according to claim 1, wherein the substrate layer comprises glass.

8. The bubble-actuated valve according to claim 1, wherein the cap layer comprises silicon.

10 9. The bubble-actuated valve according to claim 1, wherein the cap layer comprises a polymeric material.

15 10. The bubble-actuated valve according to claim 1, wherein the cap layer comprises a ceramic material.

11. The bubble-actuated valve according to claim 1, wherein the cap layer comprises glass.

20 12. A miniature, bubble-actuated valve comprising:
a substrate layer;
a cap layer;
at least one fluid inlet formed in at least one of the substrate layer and the cap layer
25 at least one fluid outlet formed in at least one of the substrate layer and the cap layer;
at least one flow channel, formed in at least one of the substrate layer and the cap layer, connecting the at least one fluid inlet to the at least one fluid outlet;
30 at least one device for creating a bubble;
a moveable solid object, the moveable solid object being moveable between a first position, wherein fluid flows from the at least one fluid inlet to the at least one fluid outlet, and a second

position, wherein fluid flow from the at least one fluid inlet to the at least one fluid outlet is blocked, the moveable solid object being moved by at least one of the bubble and the force generated by the creation of the bubble; and

5 a latching mechanism for latching the moveable solid object when the valve is powered down.

13. The miniature, bubble-actuated valve according to claim 12, wherein the substrate layer comprises silicon.

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14. The miniature, bubble-actuated valve according to claim 12, wherein the substrate layer comprises a polymeric material.

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15. The miniature, bubble-actuated valve according to claim 12, wherein the substrate layer comprises a ceramic material.

16. The miniature, bubble-actuated valve according to claim 12, wherein the substrate layer comprises glass.

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17. The miniature, bubble-actuated valve according to claim 12, wherein the cap layer comprises silicon.

18. The miniature, bubble-actuated valve according to claim 12, wherein the cap layer comprises a polymeric material.

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19. The miniature, bubble-actuated valve according to claim 12, wherein the cap layer comprises a ceramic material.

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20. The miniature, bubble-actuated valve according to claim 12, wherein the cap layer comprises glass.

21. The miniature, bubble-actuated valve according to claim 12, wherein the at least one device for creating a bubble comprises a heating element positioned in at least one of the substrate layer and the cap layer.

5 22. The miniature, bubble-actuated valve according to claim 21, wherein the heating element is a resistive heating element.

10 23. The miniature, bubble-actuated valve according to claim 12, wherein the at least one device for creating a bubble comprises an electrolytic device operatively associated with at least one of the substrate layer and the cap layer.

15 24. The miniature, bubble-actuated valve according to claim 12, wherein the at least one device for creating a bubble comprises a gas supply operatively associated with at least one of the substrate layer and the cap layer.

20 25. The miniature, bubble-actuated valve according to claim 12, wherein the moveable solid object comprises a spherical element.

26. The miniature, bubble-actuated valve according to claim 12, wherein the moveable solid object comprises a tethered mechanism.

25 27. The miniature, bubble-actuated valve according to claim 12, wherein the moveable solid object comprises a bistable object.

28. The miniature, bubble-actuated valve according to claim 12, wherein the latching mechanism comprises a small gas reservoir in at least one of the substrate layer and the cap layer.

30 29. The miniature, bubble-actuated valve according to claim 12, wherein the latching mechanism comprises a latching actuator.

30. A miniature bubble-actuated valve comprising:

- a substrate layer;
- a cap layer;
- at least one fluid inlet formed in at least one of the substrate layer and the cap layer;
- 5 at least one fluid outlet formed in at least one of the substrate layer and the cap layer;
- at least one flow channel, formed in at least one of the substrate layer and the cap layer, connecting the at least one inlet to the at least one outlet, wherein the at least one inlet and the at least one outlet are in the same plane of the at least one flow channel;
- 10 at least one device for forming a bubble; and
- at least one moveable object, the moveable solid object being moveable between a first position, wherein fluid flows from the at least one inlet to the at least one outlet, and a second position, wherein fluid flow from the at least one inlet to the at least one outlet is blocked, the moveable solid object being moved by at least one of the bubble and the force generated by the formation of the bubble.
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31. A miniature bubble-actuated valve comprising:

- a substrate layer;
- a cap layer;
- 25 at least one fluid inlet formed in at least one of the substrate layer and the cap layer;
- at least one fluid outlet formed in at least one of the substrate layer and the cap layer;
- at least one flow channel formed in at least one of the substrate layer and the cap layer, connecting the at least one inlet to the at least one outlet, wherein the at least one inlet and the at least one outlet are out of the plane of the at least one flow channel;
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at least one device for forming a bubble; and
a moveable object, the moveable solid object being
moveable between a first position, wherein fluid flows from the at
least one inlet to the at least one outlet, and a second position,
wherein fluid flow from the at least one inlet to the at least one
outlet is blocked, the moveable solid object being moved by at
least one of the bubble and the force generated by the formation
of the bubble.

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10 32. A miniature, bubble-actuated valve comprising:
 a substrate layer;
 a intermediate layer;
 a cap layer;
 at least one fluid inlet formed in at least one of the
 substrate layer, the intermediate layer and the cap layer;
 at least one fluid outlet formed in at least one of the
 substrate layer, the intermediate layer and the cap layer;
 at least one flow channel, formed in at least one of the
 substrate layer, the intermediate layer and the cap layer,
 connecting the at least one inlet to the at least one outlet;
 at least one device for forming a bubble; and
 a moveable object, the moveable solid object being
moveable between a first position, wherein fluid flows from the at
least one inlet to the at least one outlet, and a second position,
wherein fluid flow from the at least one inlet to the at least one
outlet is blocked, the moveable solid object being moved by at
least one of the bubble and the force generated by the formation
of the bubble.

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30 33. A valve system comprising:
 one or more bubble-actuated valves, each valve including
 a substrate layer, a cap layer, at least one inlet formed in at least
 one of the substrate layer and the cap layer, at least one outlet

formed in at least one of the substrate layer and the cap layer, at least one flow channel, formed in at least one of the substrate layer and the cap layer, connecting the at least one inlet to the at least one outlet, at least one device for forming a bubble, and a moveable object, the moveable solid object being moveable between a first position, wherein fluid flows from the at least one inlet to the at least one outlet, and a second position, wherein fluid flow from the at least one inlet to the at least one outlet is blocked, the moveable solid object being moved by at least one of the bubble and the force generated by the formation of the bubble; and

one or more fluid conduits interconnecting the one or more bubble-actuated valves.

15 34. A method for controlling fluid flow in a valve comprising:
 forming a first bubble to move a solid object from a first position to a second position, thereby blocking the flow of liquid from the inlet of the valve to the outlet of the valve; and
 forming a second bubble to move the solid object from the second position to the first position, thereby allowing the flow of liquid from the inlet of the valve to the outlet of the valve.

20 35. A bubble-actuated valve comprising:
 at least one inlet;
 at least one outlet;
 at least one flow channel connecting the at least one inlet to the at least one outlet;
 at least one device for forming a bubble; and
 a moveable solid object, the moveable solid object being moveable between a first position, wherein fluid flows from the at least one inlet to the at least one outlet, and a second position, wherein fluid flow from the at least one inlet to the at least one outlet is blocked, the moveable solid object being moved by at

least one of the bubble and the force generated by the formation of the bubble.